DOCUMENT RESUME

ED 255 791 CG 018 123

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TITLE Conditions Favoring a Facilitation Effect in the Learned Helplessness Paradigm.
PUB DATE Aug 83
NOTE 45p.; Paper presented at the Annual Convention of the American Psychological Association (91st, Anaheim, CA, August 26-30, 1983). Research supported by grants from the Foundation of California State University, Sacramento.
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Arousal Patterns; Attribution Theory; College Students; Females; Heart Rate; *Helplessness; Higher Education; *Individual Power; Locus of Control; Noise (Sound); *Performance Factors; Psychological Patterns; *Stress Variables
IDENTIFIERS Moods

ABSTRACT

Following a traditional learned helplessness paradigm, subjects initially tried to terminate random bursts of noise using a button-pressing manipulandum and next tried to solve 20 serially-presented anagrams. The noise was broadcast at either a loud or soft intensity, and the subject's button-pressing was either successful (Escape condition) or unsuccessful (Inescape condition) in terminating the noise or, in a control (Signal) condition, served as a cue to the experimenter that the noise had been heard. In Experiment 1, subjects were evenly divided between males and females and the manipulandum had two buttons available for pressing. Although the Inescape group perceived itself as having virtually no control over the noise, there was little evidence among these subjects of the debilitation in anagram performance which is characteristic of learned helplessness. Instead, the performance of females exposed to inescapable soft noise was significantly facilitated relative to that of females in the Escape and Signal groups. In Experiment 2, all subjects were female, and the manipulandum had either one or two buttons on it. Once again, the anagram performance of subjects in the Inescape group was somewhat better than that of subjects in the Escape and Signal groups. Combined data for female subjects using a two-button manipulandum in Experiments 1 and 2 showed clear evidence of facilitated performance among those exposed to inescapable soft noise. Self-reported symptoms of arousal and mood as well as directly monitored heart rate suggested that subjects' internal states strongly influenced their task performance. Four pages of references conclude the document. (Author)

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Conditions Favoring A Facilitation Effect in the Learned Helplessness Paradigm

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First Page Note: This research was supported by grants to the first author from the Foundation of California State University, Sacramento. Appreciation is expressed to the following students who assisted with various aspects of the project: Linda Bailey, Richard Froman, Carrie Heck, Ann Irwin, Keith Martin, Shelley Roesch, and Teresa Viles. Special thanks are extended to Roger Reaume, electronics technician to the psychology department, who designed and fabricated the noise control apparatus. Requests for reprints should be sent to Dr. William Samuel, Department of Psychology, California State University, Sacramento, CA 95819.

CG 018123

Abstract

Following a traditional learned helplessness paradigm, subjects initially tried to terminate random bursts of noise using a button-pressing manipulandum and next tried to solve 20 serially-presented anagrams. The noise was broadcast at either a loud or soft intensity, and the subject's button-pressing was either successful (Escape condition) or unsuccessful (Inescape condition) in terminating the noise or, in a control (Signal) condition, served as a cue to the experimenter that the noise had been heard. In Experiment I, subjects were evenly divided between males and females and the manipulandum had two buttons available for pressing. Although the Inescape group perceived itself as having virtually no control over the noise, there was little evidence among these subjects of the debilitation in anagram performance which is characteristic of learned helplessness. Instead, the performance of females exposed to inescapable soft noise was significantly facilitated relative to that of females in the Escape and Signal groups. In Experiment II, all subjects were female, and the manipulandum had either one or two buttons on it. Once again, the anagram performance of subjects in the Inescape group was somewhat better than that of subjects in the Escape and Signal groups. Combined data for female subjects using a two-button manipulandum in Experiments 1 and 2 showed clear evidence of facilitated performance among those exposed to inescapable soft noise. Self-reported symptoms of arousal and mood as well as directly monitored heart rate suggested that subjects' internal states strongly influenced their task performance.

Conditions Favoring A Facilitation Effect in the Learned Helplessness Paradigm

Most investigations of learned helplessness in humans have presented subjects with a problem-solving task involving uncontrollable physical or psychological stressors (e.g., noise or failure) and have found that subsequent task performance was undermined relative to the achievement shown by a group exposed to controllable stressors, the classic laboratory demonstration of this phenomenon being four experiments reported by Hiroto and Seligman, 1975. Sometimes, though, it has been found that subjects exposed to uncontrollable stressors show a subsequent facilitation of performance (see, e.g. Boyd, 1982; Glass & Carver, 1980, pp. 233-234; Hanusa & Schulz, 1977; Pittman & Pittman, 1980; Poulton, 1976; Roth & Bootzin, 1974; Roth & Kubal, 1975; Tennen & Eller, 1977; Thornton & Jacobs, 1972; Wortman et al., 1976). Wortman and Brehm (1977) attempted to reconcile facilitation and learned helplessness by means of reactance theory. Another approach has been to examine attributions made by subjects who have experienced a lack of control over aversive events (Abramson et al., 1978). Following Weiner's (1974) theoretical model, attributions may be classified as internal vs. external or as stable vs. unstable. It is when attributions for one's inability to control such events are stable and especially when they are internal (i.e., to lack of skill) that learned helplessness is most likely to persist. When attributions are made to unstable factors such as lack of effort or bad luck, one is likely to engage in renewed efforts at coping. Though there have been some recent disconfirmations of the attributional model by Oakes and

Curtis (1982) and Tennen et al. (1982), interest in this approach remains strong (Alloy, 1982).

Aside from the influence of attributions on the helplessness phenomenon, one might also examine the states of physiological arousal that are known to be generated by stressors like loud noise or failure. According to the well-known inverted-U relationship between arousal and performance, exposure to stressors may either facilitate or debilitate subsequent performance depending on whether they stimulate a moderate or an excessively high degree of arousal, respectively (see Bargh & Cohen, 1978; Doob & Kirshenbaum, 1973; Duffy, 1957; Garber, Miller & Abramson, 1980, p. 41; Malmo, 1959; Samuel et al., 1978; Sharma, 1970).

The intensity and duration as well as the controllability of the aversive stimulus would all seem to be related to the degree of arousal it produces and, hence, to the likelihood of observing a facilitation or debilitation of subsequent performance. Glass and Singer (1972, pp. 45-55) reported that subjects exposed to 23-25 bursts of loud (108dB), randomly intermittent noise made fewer attempts at solving a set of puzzles than did subjects exposed to an equal number of bursts of regularly scheduled noise. Subjects exposed to soft noise (56dB) in the same experiment showed the same helplessness-like performance deficit following unpredictable as compared to predictable noise, but to a significantly lesser degree than their counterparts in the loud noise group.

In another experiment, Glass and Singer (1972, pp. 61-69) found that subjects who perceived they had no control over 23 bursts of loud

unpredictable noise subsequently made fewer attempts at solving the puzzles than did subjects who perceived they could control the noise. Similarly, Krantz, Glass, and Snyder (1975) observed that exposure to 35 bursts of loud (105dB) unpredictable noise impaired subsequent avoidance learning when the noise was inescapable but did not impair subsequent performance when it was escapable. This effect was found only for subjects having a Type A "coronary prone" personality, however. Those possessing the contrasting Type B personality were, in a later study, found to have their reaction time performance facilitated by preliminary exposure to 12 bursts of inescapable loud noise while Type A's showed the usual debilitation effect (Glass & Carver, 1980, pp. 233-234). Possibly, as Glass and Carver themselves suggested, Type A's are more chronically aroused than B's and so may be more susceptible to having their task performance disrupted by an aversive stimulus. Type B's, by contrast, may have their relatively low levels of arousal raised to a more optimally motivating, moderate level by exposure to such a stimulus. Glass and Carver preferred to interpret their results in terms of a tendency of Type A's to ignore low intensity feedback of stimulus uncontrollability but to be hyperattentive to high intensity feedback. They could not rule out arousal as a possible alternative interpretation, however.

Regardless of someone's personality type, there is a wealth of self-report and physiological data which support the notion that inescapable, as compared to escapable, aversive stimulation is significantly more irritating, frustrating, unpleasant, and arousing (Corah & Boffa, 1970; Geer et al., 1970; Glass & Singer, 1972, p. 66;

Hiroto & Seligman, 1975; Pennebaker et al., 1977; Roth & Bootzin, 1974; Roth & Kubal, 1975; Solomon et al., 1980; Szpiler & Epstein, 1976; Tennen & Eller, 1977; Wortman et al., 1976). Thus, anyone's arousal state and, hence, task performance could be influenced by the stimuli employed in the typical learned helplessness experiment.

Finally, the particular task employed in the classical helplessness research paradigm may influence subjects' arousal states as well as the obtained results. Typically, subjects have been pretreated with bursts of loud random noise that either were or were not controllable by means of pressing a single button. A subsequent performance impairment on an anagrams task on the part of the inescapable noise group was taken as evidence of learned helplessness. One must consider, however, that there are only a limited number of ways of pushing a single button. The inescapable group may simply have exhausted all the plausible button-pressing combinations on the early trials and then concluded (quite correctly) that the experimenter was deliberately frustrating them with an unworkable manipulandum. When the anagrams task commenced, these subjects would naturally have assumed that the experimenter was frustrating them once again and that the jumbled letters really could not be rearranged to make words. Such beliefs would have caused subjects in the inescapable group to take a long time to catch on to the anagrams task, thus making them appear "helpless" rather than just suspicious. Costello (1978) commented extensively on these and other demand characteristics in the classical learned helplessness experiment. Moreover, if a one-button manipulandum <u>is</u> an inherently frustrating component of the helplessness paradigm, it is likely to make its own

independent contribution toward elevating the subject's arousal state. Boyd (1982) has in fact already proposed that learned helplessness might be reinterpreted as a frustration-induced response pattern.

Several of the studies reporting facilitation effects sought to manipulate the degree to which the subject was exposed to an uncontrollable aversive stimulus (see Pittman & Pittman, 1970; Roth & Bootzin, 1974; Roth & Kubal, 1975; Tennen & Eller, 1977). In general, it seemed that a mild dose of an uncontrollable aversive stimulus often facilitated subsequent performance whereas a stronger dose usually debilitated it. Since we were especially interested in facilitation effects, we designed our experiments so as to incorporate uncontrollable stimuli that were of relatively low aversiveness. In the first experiment, a two-button manipulandum was employed so subjects in the inescapable group could never be sure they had exhausted all response combinations and could not thereby become excessively frustrated by the manipulandum itself. Noise was broadcast at either a loud or a soft intensity, and the number of noise bursts was limited to 20, just at the lower boundary of noise exposure that has been found to induce learned helplessness in earlier research. It was anticipated that the learned helplessness phenomenon would be replicated when the noise was loud but that, when the noise was soft, a facilitation effect would appear.

In order to investigate the role of attributions in the learned helplessness phenomenon, we measured subjects' expectancies and attributions for anagram performance. The rationale for making this

assessment was that, in the reformulated learned helplessness model by Abramson et al. (1978), perceived control or lack of control on the pretreatment task should lead to expectancies of control or lack of control, respectively, on the anagrams. Specifically, subjects in the Escape group should do relatively well on the anagrams and should be likely to attribute their performance to such positive factors as ability, effort, or the easiness of the task. Subjects in the Inescape group should do relatively poorly on the anagrams and should, consequently, make stronger attributions to negative factors like lack of ability or effort or the difficulty of the task. We expected that Inescape subjects showing a facilitation effect would express attributions comparable to those of subjects in the Escape condition.

EXPERIMENT 1

METHOD

Design Overview

Subjects first manipulated a pair of bushbuttons in an effort at controlling the offset of randomly-timed bursts of noise broadcast over headphones. They next attempted to solve 20 sequentially-presented five-letter aragrams. Throughout this period, subjects' heart rate and GSR were continuously monitored. The design was a 2 x 3 x 2 factorial varying the intensity of the noise (loud or soft), the contingency applied to the pushbuttons (Escape, Inescape, or Signal) and the sex of the subject. Subjects evaluated the loudness and controllability of the noise and made attributions for anagram performance to good or bad luck, effort or lack of effort, easiness or difficulty of the task, and ability or lack of ability.

Subjects

The subjects were 64 male and 64 female undergraduates completing a research participation requirement in their introductory psychology classes. Data for 4 male and 4 female subjects were discarded due to mechanical problems with the equipment. The final sample consisted in 60 male and 60 female undergraduates, 10 in each of the 12 cells of the design.

Apparatus

The noise broadcast and control apparatus was a custom-designed unit fabricated by technical staff at the Electronics Support Center on the state university campus. The unit incorporates an Opamp Labs "pink noise generator," which broadcasts randomly-selected frequencies of audible noise at equal energy levels. Noise onset and offset at the headphones was controlled by a timing tape played on a stereophonic cassette deck [SAE model C3D]. A second channel of this tape recorded the time of offset of noise bursts as modified by the button-pressing of subjects in the Escape condition. The button-pressing manipulandum consisted in a 100 x 164 mm. box with two square buttons (19 x 19 mm.) labeled "A" and "B". Centered above the buttons was a small red light labeled "ESCAPE".

Noise heard by the subject was broadcast at either a 90 dB SPL or a 70 dB SPL intensity, calibrated and continuously monitored by a sound pressure level meter. The headphones worn by the subject (Telex Model 2400) were fitted with a microphone which facilitated communication with the experimenter during the anagrams task.

The anagrams were displayed to the subject by means of a Kodak Carousel slide projector placed in a cabinet commercially manufactured

for this purpose by Lehigh Valley Electronics. The five-letter anagrams were shown in white letters on a black background and were 12 mm. high on the viewing screen, which was mounted on a tabletop surface directly in front of the subject. After a slide appeared, the time it took for a subject to solve it was recorded by means of a Hunter timer. The experimenter manually stopped the timer when the subject announced the solution over an intercom that was continually broadcasting from the subject's cubicle to the experimenter's equipment room. Pretesting had demonstrated that nearly all solved anagrams had durations of exposure less than one minute. Consequently, if a subject had not solved an anagram within 60 sec., the equipment automatically removed it from the screen and, after a delay of 7 sec., moved on to the next anagram in the sequence.

Physiological recordings were taken using a "Physiograph 6," a tube-type unit manufactured by E&M Instrument Company, which has since been acquired by Narco Bio-Systems, Inc. For GSR, we used Narco Bio silver/silver chloride recording electrodes (11 mm. diameter) and Redux Creme electrode paste. These were connected to a Narco Bio GSR preamplifier. For heart rate we used a Narco Bio photoelectric pulse pick-up. The arm of the subjects' chair corresponding to the arm to which the recording devices were attached was fitted with a comfortable pad designed to minimize random movements during the noise exposure and anagrams tasks.

Procedure

The project was described as a study of the effects of noise pollution on mood and behavior. After hearing a sample of the noise to which he or she would be exposed, each subject signed a consent form

and, following attachment of the recording electrodes for heart rate and GSR to the hand and forearm of his or her non-preferred arm, rested quietly for about 5-7 minutes. Subjects were left alone and seated comfortably in a small room during this period, and baselines were established for heart rate and skin resistance. The chart paper on the Physiograph 6 had a 5 mm. grid, and the GSR baseline was adjusted so that the standard 10K resistance moved the recording pen five squares (i.e., each square corresponded to a change in skin resistance of 2000 ohms). This level of sensitivity was selected so as to minimize the extent to which changes in the subject's baseline would drive the recording pen to the limit of its scale.

The photoelectric pulse transducer was attached to the middle finger of the subject's hand using an elastic cuff with a velcro fastener. One GSR electrode was placed on the palm of the hand on the side opposite the subject's thumb, and the other was placed on the subject's forearm. The GSR electrodes were attached using adhesive washers. All subjects washed their nondominant hand and forearm with Ivory soap prior to placement of the recording electrodes. The experimenter during this phase of the procedure was always the same sex as the subject.

At the end of the rest period, the experimenter announced over the subject's headphones the commencement of the noise exposure task. Subjects in the Escape and Inescape groups were told that, when a noise came on, there was a way they could stop it using the pushbuttons. They were told that a simple sequence of button pushes would terminate the noise and were encouraged to try out as many sequences as they had

time for during a given burst. They were told that if their sequence was successful in stopping the noise the ESCAPE light above the buttons would momentarily flash, while if the light did not flash it meant that the noise lasted for its programmed duration and was unaffected by their button-pressing. For the Escape group, the noise stopped whenever button "A" was pushed four times. For the Inescape group, no sequence of button pushes was effective in stopping the noise. Subjects in the Signal group were told to push button "A" just once when a burst began as a signal that they heard it. Subjects in all groups used their preferred hand to manipulate the pushbuttons.

Following these instructions, 20 bursts of either loud (90 dB) or soft (70 dB) filtered noise were broadcast over headphones. The duration of the bursts ranged from 3 to 7 sec., with an average length of 5 sec. The interburst interval was randomly varied from 7 to 13 sec. and averaged 10 sec.

Each subject in the Inescape and Signal groups was yoked for noise with a subject in the Escape group. That is, noise onset and offset as modified by the button-pushing of a given subject in the Escape condition were recorded, and this recording (actually a timing tape which gated pink noise to the headphones) was played back to yoked subjects in the Inescape and Signal conditions.

Following the noise exposure task, subjects were asked to evaluate their internal state using a rating scale taped to the wall in front of them. The scale was labeled "Not at all" (0), "Slightly" (3), "Somewhat" (6), and "Extremely" (9). The subject responded with a number on this scale to queries as to hunger, stomach queasiness,

headache, thirst, moist palms, chilliness, and increase in heart or breathing rates.

Subjects were next informed that they would be solving some anagram problems to be displayed on a screen in front of them. A slide projector for this purpose was then activated and remotely controlled by the experimenter in the adjoining equipment room, which had a one-way window into the subject's cubicle. There were 20 anagrams; each was 5 letters long and was shown for 60 sec. or until the subject called out the correct answer. The anagrams were selected from a list of anagrams and normative solution times published by Tresselt and Mayzner (1966). Each anagram had only one possible solution, and each was arranged in the order 3-4-2-5-1 relative to the order of letters in the solution word.

When the anagrams task was completed, the subject was disconnected from the recording equipment and escorted to another room to complete some questionnaires. These included, using scales running from "Not at all" (0) to "Extremely" (9), self-evaluations of "good mood," "alert and awake," "tense or anxious loudness of the noise, control over noise offset, and being made to feel "upset" by the noise. On another form, subjects evaluated their performance on the anagrams using a scale running from "Far below average" (1) to "About average" (4) to "Far above average" (7). They then were told exactly how many anagrams they had solved correctly and used a scale labled "Not at all a cause" (0) and "Very much a cause" (9) to attribute their performance to good or bad luck, effort or lack of effort, easiness or difficulty of the task, and ability or lack of ability. They also indicated how many anagrams

they would expect to solve if they repeated the task using a new set of 20 anagrams. Finally, each subject completed a test anxiety scale (Alpert and Haber, 1960). For 9 of the items on this scale, agreement testifies to a facilitating effect of anxiety on performance while for 10 of the items agreement testifies to a debilitating effect.

After completing the questionnaires, the subject was given an opportunity to ask questions and to volunteer any guesses as to the hypotheses being investigated. He or she was then given a brief description of the design of the experiment and the overall purposes of the research. The subject was sworn to secrecy regarding this information for the remainder of the semester and was then thanked for his or her participation and released.

Reduction of the Physiological Data

A heart rate baseline was taken during one minute toward the end of the rest period. Heart rate was also measured during the first and last minutes of the noise exposure tasks and during the first and last minutes of the anagrams task.

The GSR data were directionally supportive of those obtained for heart rate but attained, at best, a marginal level of statistical reliability. Consequently, these results were not considered in the present report.

RESULTS

Effectiveness of the Manipulations

Subjects in the Escape group attained a criterion of three consecutive escapes in an average of 3.3 trials. Subjects in the Inescape

group perceived themselves as having much less control over the noise ($\underline{M}$ = 1.07) than did subjects in the Escape ($\underline{M}$ = 6.92) or Signal groups ($\underline{M}$ = 3.37; $\underline{F}$ = 59.31, 2/108 $\underline{df}$, $p < .001$). The elevated mean for the Signal group is slightly puzzling since these subjects had no more control over the noise than did their counterparts in the Inescape condition. It may be, however, that performing the simple, repetitive task of pushing a button to signal a noise burst gave some subjects an illusory sense of control. Subjects in the Inescape condition, who pushed the buttons many times during 20 consecutive unsuccessful attempts at stopping the noise, appear to have had no such illusions of control.

As one would expect, subjects exposed to loud noise rated the noise considerably louder ($\underline{M}$ = 6.12) than did subjects exposed to soft noise ($\underline{M}$ = 4.38; $\underline{F}$ = 27.80, 1/108 $\underline{df}$, $p < .001$). A Pretreatment x Gender interaction in these loudness ratings will be discussed further on.

Task Performance

Cell means for the three performance measures are shown in Table 1. Number wrong and solution latency are self-explanatory, the maximum

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Insert Table 1 about here.

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score for the former being 20 and the latter being 60. Trials to criterion is a statistic derived from Hiroto and Seligman (1975) and refers to the number of trials prior to solving three consecutive anagrams within 15 sec. each. This criterion was interpreted by Hiroto and Seligman as indicating that the subject had "caught on" to the 3-4-2-5-1 ordering of the anagrams, but we found during pretesting

that many subjects who achieved this criterion went on to miss a significant proportion of the remaining anagrams. It was for this reason that we, unlike Hiroto and Seligman, did not inform subjects that there might be a pattern to the anagrams. In the pretesting, it seemed that this instruction increased variability in the anagram solution data as some subjects spent an excessive amount of time looking for patterns.

On number wrong we observed a significant Noise x Pretreatment x Gender interaction ($F = 3.18$, 2/108 df, $p < .05$). Specific comparisons within males turned up no significant differences (all Fs < 2.70). Among females, specific comparisons revealed that subjects in the Soft-Inescape condition performed exceptionally well on the anagrams--significantly or near-significantly better than their counterparts in the Loud-Inescape ($F = 5.48$, $p < .05$) and Soft-Escape conditions ($F = 3.84$, $p < .055$) and marginally better than subjects in the Soft-Signal condition ($F = 3.36$, $p < .10$).

There was also a Noise x Condition x Gender interaction in the solution latency data ($F = 3.69$, 2/108 df, $p < .05$). Only one specific comparison was significant among males, Soft-Inescape versus Soft-Signal ($F = 3.97$, $p < .05$). Among females, there was further evidence of exceptional performance in the Soft-Inescape condition. The solution latency in that cell was significantly shorter than in the Loud-Inescape ($F = 8.88$, $p < .01$), Soft-Escape ($F = 5.34$, $p < .05$), and Soft-Signal ($F = 5.53$, $p < .05$) conditions.

To sum up, for males exposed to soft noise and females exposed to loud noise, the pattern of results was generally consistent with learned

helplessness, but specific comparisons showed that in neither case was the mean for the inescapable noise group even marginally higher than that for the escapable noise group. In fact, for male subjects there is little if any evidence that the experimental manipulations had a significant effect on their anagram performance. The three-way interactions developed primarily from a strong facilitative effect of inescapable soft noise on the performance of female subjects.

Self-Rated Arousal and Mood

Shown in Table 2 are the cell means for self-report indices of autonomic arousal and mood. The arousal measure consisted in a summed score for the five classic symptoms of arousal on the list of symptoms rated by the subject at the conclusion of the noise exposure task (i.e., queasiness, thirst, moist palms, increased heart and breathing rates). The summed score could range from 0 to 45.

Insert Table 2 about here.

Analysis of the arousal measure turned up main effects for Pretreatment (F = 4.84, 2/108 df, $p < .01$) and Noise (F = 3.72, 1/108 df, $p < .06$). Subjects reported themselves to be more aroused in the Escape (M = 16.00) and Inescape (M = 14.45) pretreatments than in the signal condition (M = 11.07). They were more aroused after listening to loud (M = 15.11) as opposed to soft noise (M = 12.57).

Main effects for Pretreatment (F = 8.84, 2/108 df, $p < .001$) and Noise (F = 4.98, 1/108 df, $p < .05$) were also observed in subjects' self-ratings of how upset they were by the noise, and in addition there was a Pretreatment x Noise x Gender interaction in these data

(F = 3.80, 2/108 df, $p < .05$). Not surprisingly, the Inescape group was most upset (M = 5.95), followed by the Signal (M = 4.20) and Escape (M = 3.82) groups. Subjects in the Loud condition were more upset (M = 5.15) than were subjects in the Soft condition (M = 4.17). The three-way interaction resulted primarily from the fact that females in the Soft--Inescape condition (who performed best on the anagrams) were the most upset group of all.

Females in the Inescape condition appeared to be especially sensitive to the noise when they evaluated its loudness. They heard the noise as being louder (M = 6.10) than did females in the Signal (M = 4.80) or Escape (M = 5.25) conditions whereas males generally heard the noise as louder in the Signal (M = 5.95) than in the Inescape (M = 5.00) or Escape (M = 4.40) conditions. The Pretreatment x Gender interaction arising from this pattern of mean differences was statistically significant (F = 4.69, 2/108 df, $p < .01$). The subject's sex did not interact with the pretreatment variable, however, in the mood ratings. Males and females exposed to inescapable noise were in less of a good mood (M = 4.45) than were their counterparts in the Escape (M = 5.05) and Signal conditions (M = 5.68; F = 3.63, 2/108 df, $p < .05$).

Physiological Arousal

Heart rate constituted our best direct measure of arousal. As one would expect, there were no marginal or significant differences in heart rate between groups during a one-minute baseline measurement period which concluded just prior to the introduction of the experimental manipulations (Grand Mean = 75.1 bpm). During the first minute of noise exposure, however, there were significant increases in heart rate

as a function of Pretreatment (F = 10.84, 2/108 df, $p < .001$), Noise Level (F = 8.42, 1/108 df, $p < .01$), and Sex of Subject (F = 5.97, 1/108 df, $p < .02$). The increase in heart rate was greater in the escapable and inescapable noise conditions (M = 4.65 and 3.83, respectively) than in the passive listening condition, where it actually decreased (M = -1.12). Heart rate increased more for subjects listening to loud (M = 4.04) rather than soft (M = 0.75) noise and for female (M = 3.78) than for male subjects (M = 1.10). Heart rate was also higher for female than for male subjects at the beginning and at the end of the anagrams task (Fs = 3.43 and 4.64, ps < .06 and .05, respectively).

The sexes also differed in the strength of correlations between various dependent measures and heart rate change from baseline to the first minute of noise exposure (called HR change). For females, HR change was significantly correlated with number wrong (r = .30, $p < .01$) and solution latency (r = .26, $p < .05$) on the subsequently-administered anagrams task, but not so for males (r = .16 and .20, respectively). HR change was also significantly correlated with combined arousal symptoms for females (r = .33, $p < .01$) but not so for males (r = .19). Among both males and females, HR change was significantly correlated with self-reported stomach queasiness (r = .31, $p < .01$), increased heart rate (r = .17, $p < .05$), and increased breathing rate (r = .23, $p < .01$).

Attributions for Performance

Few significant effects were found on measures of subjects' attributions for task performance. It was found, however, that males (M = 5.29) were more inclined than females (M = 4.05) to attribute their performance to lack of ability (F = 6.35, 1/108 df, $p < .01$). At the

same time, males ($\underline{M}$ = 13.40) set higher goals for themselves than did females ($\underline{M}$ = 11.44) in terms of the number of anagrams they expected to get correct if the task was repeated ($\underline{F}$ = 4.45, 1/108 $\underline{df}$, $p < .05$). Males also gave themselves a slightly higher evaluation (M = 3.63) of their performance on the just-completed anagrams task than did females ($\underline{M}$ = 3.20; F = 3.11, 1/108 $\underline{df}$, $p < .10$).

DISCUSSION

We achieved, at best, only a directional replication of the learned helplessness phenomenon reported by Hiroto and Seligman (1975). The differences between means for task performance under these circumstances were quite small, however, and not at all significant. The significant finding in our results was that exposure to inescapable soft noise had a facilitating effect on the performance of female subjects relative to that observed following escapable noise or passive listening. This effect is the opposite of learned helplessness and leads one to wonder whether the phenomenon can be replicated using a two-button paradigm.

One plausible explanation for our data for female subjects is in terms of the curvilinear relationship between internal arousal and task performance. That is, females exposed to soft noise were in an under-aroused state but became more optimally, moderately aroused when stimulated by an inescapable contingency, thus facilitating their performance. When the noise was loud, however, females tended to become overaroused when frustrated by the inescapable contingency and so showed a slight impairment of performance on the anagrams.

The performance data for male subjects--essentially null results--remain difficult to interpret, but it seems reasonable to suggest that

males were, on the whole, less aroused by the noise exposure and anagrams tasks than were females. This could account for their unresponsiveness to the experimental manipulations.

On the other hand, it may be recalled from the Method section that the experimenter who interacted with the subject was a man if the subject was male but a woman if the subject was female. We did not have a sufficiently large n to completely counterbalance the sex of subject and sex of experimenter characteristics, so male and female subjects were run by different experimenters. Consequently, the gender effects we found could conceivably be due to an experimenter effect rather than to our hypothesized sex difference in responsiveness to the manipulations.

In any event, the sex of the experimenter is theoretically irrelevant to the learned helplessness phenomenon, as is the loudness of the aversive stimulus, but we failed to find a performance deficit among either male or female subjects exposed to either loud or soft inescapable noise. Thinking that either the sex of subject confound or the two-button manipulandum might have interfered with our attempts at replicating learned helplessness, we designed a second experiment. This time, all subjects and the experimenter who interacted with them were female. For half of the subjects, the manipulandum had two buttons, as in Experiment 1, while for the remainder the manipulandum had one button, as in the classical learned helplessness paradigm.

EXPERIMENT 2

METHOD

Subjects

The subjects were 87 female undergraduates completing a research participation requirement, as before. Data for 3 subjects were discarded

due to mechanical problems with the equipment. There were 84 subjects in the final sample, 7 in each of the 12 cells of the design.

Apparatus

The apparatus was the same as that employed in Experiment 1. For subjects in the one-button condition, button "B" of the manipulandum was covered by a rectangular plastic cap. (30 x 60 mm.) Heart rate was recorded as in experiment 1, but GSR was not monitored in Experiment 2.

Procedure

The procedure was identical to that described for Experiment 1 in terms of yoked Escape, Inescape, and Signal groups exposed to loud or soft noise. For half of these groups, the manipulandum had just one button available while for the remaining groups both buttons were exposed. The design, then, was a 2 x 3 x 2 factorial varying Noise, Pretreatment, and Button.

At the very end of the procedure, just prior to the debriefing, subjects were asked to rate their degree of confidence that all 20 of the anagrams really could be rearranged to make words. The scale ran from "Not at all" (1) to "Extremely" (9). Using the same scale, subjects in the Inescape condition rated their confidence that there really was a way of shutting off the noise if they found the proper way to manipulate the control box.

RESULTS

Effectiveness of the Manipulations

All subjects in the Escape group attained a criterion of three consecutive escapes within the first 5 trials. As in Experiment 1,

subjects in the Inescape group perceived themselves as having much less control over the noise (M = 1.96) than did subjects in the Escape (M = 6.21) or Signal groups (M = 4.04; F = 16.44, 2/72 df, $p < .001$). Subjects exposed to loud noise rated the noise considerably louder (M = 7.43) than did subjects exposed to soft noise (M = 5.14; F = 48.34, 1/72 df, $p < .001$).

Task Performance

As can be seen in Table 3, there were no significant effects in analyses of variance for number wrong and trials to criterion, but the pattern for both the 1 Button and 2 Button conditions replicated that

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Insert Table 3 about here

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found for female subjects in Experiment 1. That is, tendencies toward a facilitating effect of inescapable noise were most apparent when the noise was soft rather than loud. For trials to criterion, there was a marginally significant main effect for Pretreatment indicating that subjects in the Inescape condition (M = 11.07) took fewer trials to reach the criterion of three consecutive anagrams within 15 sec. each than did their counterparts in the Escape (M = 15.57) or Signal conditions (M = 14.00; F = 2.60, 2/72 df, $p < .10$).

Essentially, the task performance data for Experiment 2 show no significant effects for the experimental manipulations. What trends are discernible in the data, however, suggest that the performance of females in the Inescape condition was, if anything, facilitated by the noise pretreatment relative to the performance of their counterparts in the Escape and Signal conditions.

Self-Rated Arousal and Mood

Analysis of the arousal measure revealed a main effect for Noise (F = 6.34, 1/72 df, $p < .02$) and a Pretreatment x Button interaction (F = 3.91, 2/74 df, $p < .05$). As in Experiment 1, subjects exposed to loud noise (M = 15.81) reported a greater degree of arousal than did subjects exposed to soft noise (M = 11.52). Among subjects having a one button manipulandum, self-reported arousal was higher following the Escape (M = 14.79) and Inescape (M = 17.28) than following the Signal pretreatment (M = 10.86), a pattern similar to that found in Experiment 1. Among those having a two button manipulandum, however, there was for some reason an exceptionally high degree of arousal reported in the Signal condition (M = 16.28) which reversed the direction of the effect for pretreatment found in the one button condition and caused the Pretreatment x Button interaction to appear in these data.

Subjects' self-ratings of how upset they were by the noise revealed main effects for Noise (F = 24.64, 1/72 df, $p < .001$) and Button (F = 5.66, 1/72 df, $p < .02$). They were more upset when the noise was loud (M = 6.28) rather than soft (M = 4.00) and when they had just one button to push (M = 5.69) rather than two (M = 4.59).

Physiological Arousal

Baseline heart rate (Grand Mean = 79.25 bpm) was elevated relative to that found in Experiment 1. This was due primarily to an anomolously high heart rate for subjects in the Loud-Escape cell of the 1 Button condition (M = 90.14 bpm), which caused a Pretreatment x Noise x Button interaction to appear in the baseline data (F = 3.37, 2/68 df, $p < .05$). The experimenters in Experiment 2 were not as careful as those in

Experiment 1 to give each subject at least 5 minutes of "settling down" time before initiating the noise pretreatment. Despite this problem, heart rate changes from baseline through the first minute of noise exposure were similar to those found in Experiment 1. A main effect for Pretreatment indicated that heart rate increased most for subjects in the Inescape condition ($\underline{M}$ = 4.03), next most for those in the Escape condition ($\underline{M}$ = 2.15), and decreased for those in the Signal condition ($\underline{M}$ = -1.97; $\underline{F}$ = 7.32, 2/68 $\underline{df}$, $p<.001$). The data for four subjects in the one button condition were lost due to problems with the recording apparatus.

Attributions for Performance

No significant effects of the experimental manipulations were found on measures of subjects' attributions for task performance in Experiment 2. We also found no significant effects of the manipulations on subjects' ratings of how confident they were that the anagrams really could be rearranged to make words or (for Inescape subjects only) how confident they were that there really was a way to shut off the noise by means of the pushbuttons.

Combined Results for Females Having A Two Button Manipulandum

The absence of significant effects in the task performance data of Experiment 2 should not obscure the fact that the pattern of mean differences between cells was highly comparable to that found for female subjects in Experiment 1. In fact, the 2 Button condition of Experiment 2 replicates all the procedures employed with female subjects in Experiment 1. Therefore, it should be of interest to examine Table 4, which shows the task performance data for the 102

female subjects in the replicated conditions of Experiments 1 and 2.

Insert Table 4 about here.

"Replication" was included as a factor in all analyses of the performance data but was in no case found to have a significant effect.

A Noise vs. Pretreatment interaction appeared in analyses of the number wrong (F = 3.80, 2/90 df, $p < .05$) and latency measures (F = 3.46, 2/90 df, $p < .05$). In both cases, the interaction was due to a strong facilitation effect among subjects exposed to soft noise. On trials to criterion, there was a marginally significant main effect for Pretreatment, indicating that subjects' performance was generally best following the Inescape pretreatment (F = 2.69, 2/90 df, $p < .10$).

Shown in Table 5 are means for the combined sample's self-reported heart rate change, degree of being upset by the noise, and HR change

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Insert Table 5 about here

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from baseline through the first minute of noise exposure. For self-reported heart rate, there was a significant main effect for Noise, which indicated that heart rate was perceived to have increased more following loud than soft noise (F = 4.33, 1/90 df, $p < .05$). For upset, there were main effects for Noise (F = 8.74, 1/90 df, $p < .01$) and Pretreatment (F = 4.68, 2/90 df, $p < .02$) plus a Noise x Pretreatment interaction (F = 6.02, 2/90 df, $p < .01$). These effects were due to the loud noise being more upsetting than the soft noise, the Inescape pretreatment being more upsetting than the Escape or Signal pretreatments,

and the Inescape pretreatment being particularly upsetting (relative to the Escape or Signal treatments) when the noise was soft rather than loud.

For HR change, there was a main effect for Pretreatment (F = 9.84, 2/90 df, $p<.001$) and a Noise x Pretreatment interaction (F = 3.14, 2/90 df, $p<.05$). The main effect was due to HR change being positive during the Escape and Inescape pretreatments but negative during the Signal pretreatment. The interaction developed mainly from the fact that, during loud as compared to soft noise, HR change was more positive in the Escape and Inescape pretreatments but more negative in the Signal pretreatment. It is important to note that baseline HR did not significantly differ between conditions for females using a two-button manipulandum (Grand Mean = 77.7 bpm; all Fs<1.46).

On all three measures, subjects in the Soft-Inescape group appear to have an elevated level of arousal relative to subjects in the Soft-Escape or Soft-Signal groups. These differences between pretreatment groups are either attenuated or reversed in the loud noise conditions, and this reduction in the relative magnitude of arousal in the Inescape group may have caused the facilitation effect for task performance which was observed following soft noise exposure to disappear when the noise was loud. Self-reported heart rate increase was positively correlated with the upset measure (r = .45, $p<.001$), but HR change was not significantly correlated with either of these self-report measures (rs = .06 and .01, respectively).

HR change was, though, significantly related to other measures in a manner that suggested it was meaningful to speak of an arousal state

within our subjects that influenced their task performance. HR change was positively correlated with stomach queasiness ($r = .34$, $p < .001$), summed arousal ($r = .15$, $p < .10$), number wrong ($r = .23$, $p < .02$), latency ($r = .18$, $p < .05$), perceived control ($r = .21$, $p < .02$), perceived lack of ability ($r = .20$, $p < .05$), and facilitative test anxiety ($r = .17$, $p < .05$). It was negatively correlated with good mood ($r = -.17$, $p < .05$).

GENERAL DISCUSSION

In Experiment 2, as in Experiment 1, we have clear-cut evidence that the manipulations had the intended impact on subjects' perceptions of the controllability and loudness of the noise. The results for these manipulation checks were supported by the data from physiologically-oriented dependent measures; namely, HR changes from baseline (for perceived controllability) and arousal symptoms (for perceived loudness). Circumstances were, therefore, ripe for observing learned helplessness, at least in the loud noise conditions. Yet we found no evidence that the Inescape pretreatment served to debilitate anagram performance regardless of whether the noise was loud or soft or whether the manipulandum had one or two buttons. It appears, therefore, that something beyond the mere perception of uncontrollability is required for learned helplessness to be manifested in a subject's problem-solving behavior (see also Lubow, Rosenblatt, and Weiner, 1981).

We speculated that the extra ingredient might consist in attributions, but our data showed little impact of the pretreatment manipulations on subjects' attributions for anagram performance. In a sense,

this lack of impact is consistent with our failure to observe learned helplessness, though little can be proved by null findings.

In retrospect, we should also have measured subjects' attributions for their performance on the noise pretreatment task. Oakes and Curtis (1982), Tennen, Gillen, and Drum (1982), and Tennen, Drum, Gillen, and Stanton (1982) all assessed such attributions, however, and found only very weak relationships between these cognitions and performance on a subsequently-administered anagrams test task. Oakes (1982) and Tennen (1982) interpreted their failure to find such relationships as constituting a serious challenge to the reformulated learned helplessness model. In a recently-completed experiment, though, we have seen that learned helplessness can be demonstrated using our apparatus and procedures if attributions for performance on the button-pressing task are taken into account and that these attributions determine whether a given subject's anagrams performance is facilitated or debilitated by prior exposure to inescapable noise. The role of attributions in the learned helplessness phenomenon is an issue that is likely to be debated for some time to come (see Alloy, 1982, and Silver et al., 1982, for critiques of the positions taken by Oakes, 1982, and Tennen, 1982).

In the absence of a more refined attributional analysis of the data from the present experiment, we may speculate that our failure to replicate learned helplessness was due primarily to the intensity and number of noise bursts we employed. Most researchers have used a louder aversive stimulus than our 90 dB loud noise (100 dB or more, as noted in the introduction). Since we saw evidence of a directional tendency toward learned helplessness in our loud noise condition it is

conceivable that we might have found more helplessness had we used bursts of, say, 110 dB. Another tactic for enhancing the likelihood of observing learned helplessness would have been to increase the number of noise bursts from 20 to 35 or more. At the outset of the research, however, we were confident of reproducing the often-replicated phenomenon of learned helplessness in the loud noise conditions and were mainly concerned with enhancing the likelihood of observing facilitation effects. Consequently, we chose a number of noise bursts that was at the lower boundary of the quantity found to produce learned helplessness in previous research. It may be recalled that Glass and Singer found a significant helplessness effect with 23 bursts of 108 dB loud noise but a greatly attenuated effect when the noise was soft. With 20 bursts of soft noise we found a facilitation effect which was either greatly attenuated or reversed in the direction of learned helplessness when the noise was a louder 90 dB. The two sets of results appear quite compatible with one another in suggesting that learned helplessness is associated with a greater number of uncontrollable high intensity noise bursts whereas facilitation is associated with a lesser number of low intensity bursts.

One problematic aspect of our findings is the significant effect for sex of subject reported in Experiment 1. Many investigations of learned helplessness have not specified the sex of subjects utilized (see, e.g., Thornton & Jacobs, 1972; Hiroto, 1974; Roth & Bootzin, 1974; Tennen, Gillen, & Drum, 1982; Tennen, Drum, Gillen, & Stanton, 1982). Others have suggested the number of male and female subjects but have not stated whether they analyzed for sex differences in the results

(e.g., Hiroto & Seligman, 1975; Tennen & Eller, 1977; Oakes & Curtis, 1982). Still others have utilized only, or predominantly, female participants (e.g., Wortman, et al., 1976; Gregory, et al., 1976). Consequently, there is no way of knowing just how representative or unrepresentative our finding of sex differences might be of observations made in prior research. Dweck and Licht (1980, pp. 203-207) interpret data gathered primarily in school settings as indicating that girls are more susceptible to learned helplessness than boys. If, as we propose, internal arousal is an important component of learned helplessness, then our finding that females experienced greater arousal during the noise pretreatment may be related to their presumed greater susceptibility. Consistent with Dweck and Licht's hypothesis is our finding that males expected to do significantly better than females if the anagrams task were repeated, even though there was no sex difference in actual performance on the task itself.

The one button vs. two button variable had surprisingly little effect on subjects' arousal state, task performance, attributions for performance. Perhaps this variable is not so important for the helplessness phenomenon as we had hypothesized. On the other hand, subjects did report feeling significantly more upset by the noise when they had only one button with which to control it than when they had two. Such feelings could reflect what we believe to be the more inherently frustrating nature of a one-button manipulandum. The number of response options available to the subject during a helplessness-inducing pretreatment is an intriguing variable that probably merits further study.

On the whole, our data for female subjects seem quite compatible with the arousal hypothesis advanced in the introduction. That is, a facilitation effect was observed under conditions of relatively non-arousing soft noise because the frustration induced by the Inescape treatment elevated subjects' arousal to a more optimally motivating level. Under the more arousing circumstances of exposure to loud noise, however, the frustration induced by the Inescape treatment would have served to push subjects in the direction of becoming excessively aroused and so caused the facilitation effect observed in the soft noise condition to disappear.

Especially pertinent to an arousal interpretation of our results would be a graph plotting anagram performance against arousal. Such a graph is shown in Figure 1, using number correct as the index of performance and HR change as the index of arousal. The data are from the

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Insert Figure 1 about here

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102 female subjects who used a two-button manipulandum. A oneway analysis of variance revealed that anagram performance significantly differed between HR categories, but the function is obviously different from an inverted-U ($F = 2.34$, 6/90 df, $p < .05$). A linear trend component suggests that people whose heart rates greatly increased during noise exposure did worse on the anagrams than people whose heart rates greatly decreased ($F = 4.73$, 1/90 df, $p < .05$). The appearance of the curve suggests, however, that it has two peaks: one associated with strong HR deceleration and another associated with mild HR acceleration. A

marginally significant cubic trend resulted from this twin-peaked quality of the curve ($F = 2.70$, 1/90 df, $p < .10$). A contrast was computed comparing anagram performance at these peak categories (HR deceleration of at least 3 bpm or acceleration of 1-3 bpm) with performance in all other categories, and the result was significant ($F = 9.85$, 1/90 df, $p < .001$).

There is evidence that heart rate deceleration following exposure to a psychological stressor is an indicator of increased, rather than decreased, arousal (called the "orienting response"; see Weinberger, 1971). If that is so, then the twin-peaked curve shown in Figure 1 might be compatible with the inverted-U hypothesis after all. In other words, subjects whose heart rates strongly decelerated or mildly accelerated as an initial response to noise exposure, and who might be presumed to have been moderately aroused, performed better on the anagrams task than subjects whose heart rates either remained at baseline levels or greatly increased.

Conclusion

These two experiments were noteworthy for their failure to replicate learned helplessness, despite the apparent success of the noise pretreatment manipulation in inducing the appropriate cognition of perceived lack of control among subjects in the Inescape group. At the same time, the results showed evidence of the opposite of learned helplessness--a facilitation effect--among female subjects pretreated with inescapable noise broadcast at a soft rather than a loud intensity. The data strongly suggest that the traditional manipulations used in research on learned helplessness (i.e., button-pressing and loud noise

bursts) have an impact on self-reported and directly monitored symptoms of physiological arousal. The pattern of mean differences in arousal between conditions as well as correlations between arousal and performance measures lent support to an arousal interpretation of the facilitation effect observed among female subjects.

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Table 1

Anagram Performance in Experiment 1

		Males			Females		
		Escape	Inescape	Signal	Escape	Inescape	Signal
Number Wrong[a]	Loud	8.90	8.30	9.20	9.20	10.20	8.90
	Soft	8.90	10.00	7.40	9.60	6.50	9.40
Trials to Criterion[b]	Loud	12.60	14.60	15.10	16.40	15.10	14.60
	Soft	11.90	16.90	13.70	15.50	9.90	15.30
Solution Latency[c] (sec.)	Loud	37.46	37.58	38.15	37.36	39.56	36.47
	Soft	36.21	40.88	32.65	36.80	27.25	36.87

[a] $F_{\text{pretreatment x noise x sex}} = 3.18$, 2/108 df, $p < .05$

[b] All $Fs < 1$, n.s.

[c] $F_{\text{pretreatment x noise x sex}} = 3.69$, 2/108 df, $p < .05$

Note: There were 10 subjects per cell. For each dependent measure, a higher score implies a poorer performance.

Table 2

Arousal Symptoms, Mood and Heart Rate Change
from Baseline Through the First Minute of Noise Exposure in Experiment 1

		Males			Females		
		Escape	Inescape	Signal	Escape	Inescape	Signal
Arousal Symptoms[a]	Loud	19.70	15.00	12.80	16.70	15.00	11.50
	Soft	14.00	13.80	12.90	13.60	14.00	7.10
Upset[b]	Loud	4.50	6.20	4.50	5.50	5.90	4.30
	Soft	3.70	4.60	4.50	1.60	7.10	3.50
Heart Rate Change[c] (bpm)	Loud	+7.20	+2.50	-1.50	+9.90	+8.40	-2.30
	Soft	-0.30	+0.20	-1.50	+1.44	+4.22	+0.80

[a] $F_{pretreatment} = 4.84$, 2/108 df, $p < .01$; $F_{noise} = 3.72$, 1/108 df, $p < .06$

[b] $F_{pretreatment} = 8.84$, 2/108 df, $p < .001$; $F_{noise} = 4.98$, 1/108 df, $p < .05$; $F_{pretreatment \times noise} = 2.42$, 2/108 df, $p < .10$; $F_{pretreatment \times noise \times sex} = 3.80$, 2/108 df, $p < .05$.

[c] $F_{pretreatment} = 10.84$, 2/108 df, $p < .001$; $F_{noise} = 8.42$, 1/108 df, $p < .01$; $F_{sex} = 5.97$, 1/108 df, $p < .02$

Note: The higher the mean, the greater the self-reported arousal and upset and the greater the increase in heart rate.

Table 3

Anagram Performance in Experiment 2

	One Button			Two Button		
	Escape	Inescape	Signal	Escape	Inescape	Signal
Number Wrong[a]						
Loud	9.14	8.14	9.71	9.00	9.14	7.57
Soft	9.43	7.00	7.86	9.86	7.14	11.00
Trials to Criterion[b]						
Loud	15.43	13.47	14.57	17.14	11.14	15.00
Soft	13.57	6.57	10.29	16.14	13.00	16.43
Solution Latency[c] (sec.)						
Loud	33.75	33.60	37.26	39.17	35.29	34.05
Soft	36.78	31.04	32.69	39.77	33.00	41.15

[a] $F_{pretreatment} = 1.07$, n.s.

[b] $F_{pretreatment} = 2.60$, 2/72 df, $p < .10$

[c] $F_{pretreatment} = 1.18$, n.s.

Note: There were 7 subjects per cell.

Table 4

Anagram Performance for Female Subjects in the Combined Two-Button Conditions of Experiments 1 and 2

		Escape	Inescape	Signal
Number Wrong[a]	Loud	9.12	9.76	8.35
	Soft	9.71	6.76	10.06
Trials to Criterion[b]	Loud	16.71	13.47	14.76
	Soft	15.76	11.18	15.76
Solution Latency[c] (sec.)	Loud	38.11	37.80	35.48
	Soft	38.03	29.62	38.64

[a] $F_{\text{pretreatment x noise}} = 3.30$, 2/90 df, $p < .05$

[b] $F_{\text{pretreatment}} = 2.69$, 2/90 df, $p < .10$

[c] $F_{\text{pretreatment x noise}} = 3.46$, 2/90 df, $p < .05$

Note: There were 17 subjects per cell.

Table 5

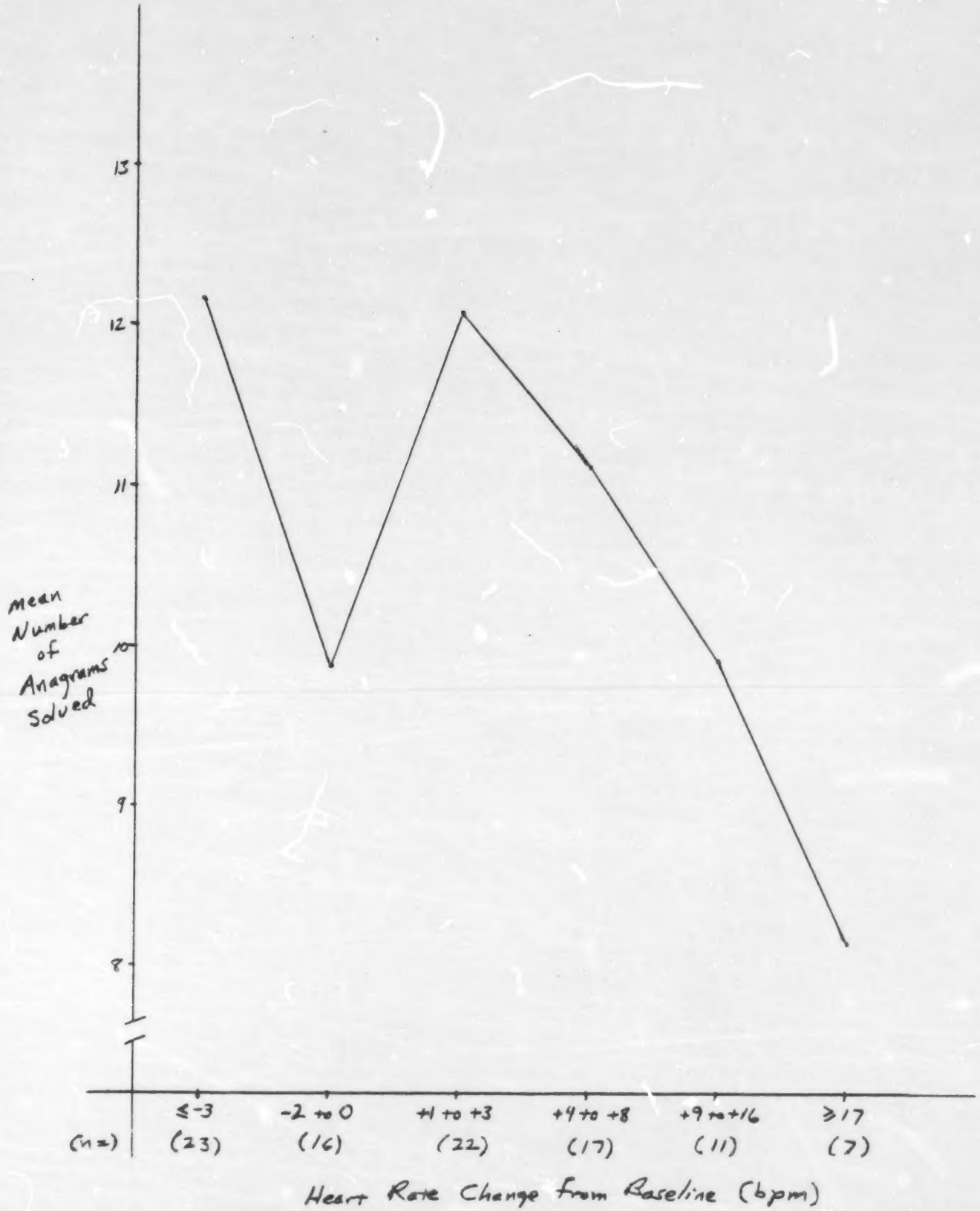
Self-reported Heart Rate Change, Mood, and Directly Monitored Heart Rate Change for Female Subjects in the Combined Two Button Conditions of Experiments 1 and 2

		Escape	Inescape	Signal
Self-reported Heart Rate[a]	Loud	4.24	4.65	3.82
	Soft	3.18	3.59	2.76
Upset[b]	Loud	5.71	5.35	4.94
	Soft	2.24	5.94	3.59
Heart Rate Change (bpm)[c]	Loud	+8.20	+5.82	-2.88
	Soft	+2.38	+3.31	- .25

[a] $F_{noise} = 4.33$, 1/90 df, $p < .05$

[b] $F_{pretreatment} = 4.68$, 2/90 df, $p < .02$; $F_{noise} = 8.74$, 1/96 df, $p < .01$; $F_{pretreatment \times noise} = 6.02$, 2/90 df, $p < .01$

[c] $F_{pretreatment} = 9.84$, 2/90 df, $p < .001$; $F_{pretreatment \times noise} = 3.14$, 2/90 df, $p < .05$.



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